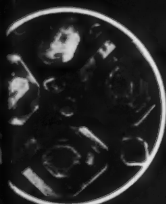
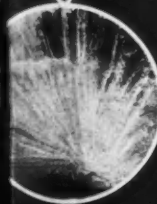


CHEMISTRY



APRIL
1950



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Editorial:

Colder Than Ever
Inside Front Cover

25¢

Colder Than Ever

► **LOW-TEMPERATURE** research opens one of the most startling fields of investigation ever to appear. We have up to now assumed as an axiom that there are three states of matter: solid, liquid and gas. We concede various crystalline forms in solids, and temporary in-between states in some liquids which foreshadow the formation of crystals, but these are details, within the structures we know. Along comes Helium II. Cool the ordinary kind of helium far enough, and it begins to do such extraordinary things that physicists are fascinated just to watch it.

Next we want an explanation for this unusual behavior in terms of the structure of matter. We want to know whether helium is unique, and if so, why? With conditions changed, will any other elements show similar phenomena—or other new ones?

Certain metals, at extremely low temperatures, show other properties that similarly promise a revision of earlier ideas. A property that especially excites practical physicists is the reaction of these materials to electricity and magnetism. Resistance seems to vanish. While a long-distance refrigerated power line would scarcely be practical, engineers are busy checking over things they would like to do with resistance-free circuits.

Superconductivity must be due to some special kind of atomic or molecular structure which allows electrons to pass without resistance. If these conditions can be understood we can hope that they may be duplicated, or imitated in some way, at temperatures nearer to those at which we live, or that power plants operating in the lower reaches of absolute temperature could be built on a practical scale.

Pure research and practical application are separated by less time lag than they used to be, and both researchers and engineers are having the time of their lives with these new opportunities.

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► CORK SINKS and iron floats, held up by magnetic repulsion, in the extremely light liquid which is helium at near zero degrees absolute. The magnetism comes from an electric current running around the metallic dish, which exhibits no resistance at this temperature.

Helium is Unique

► AN INTERNATIONAL controversy about helium, the material formed when the H-bomb or super bomb explodes, has just been settled by scientists at the National Bureau of Standards in Washington.

While the chief topic of speculation

about helium today concerns the high temperatures required for its formation in the H-bomb, this international controversy is on the behavior of helium at the other end of the temperature scale.

Dr. J. R. Pellam and R. B. Scott

investigated the behavior of helium near absolute zero. At room temperature, helium, second lightest of all elements, is a gas. It changes from a gas to a liquid at only 4.2 degrees Centigrade above absolute zero.

Absolute zero is the coldest temperature possible, 459.6 degrees below zero on the Fahrenheit scale or 273.16 degrees below zero on the Centigrade scale. At this temperature random motion of atoms and molecules ceases. At normal room temperatures atoms and molecules dash about at high speeds. The higher the temperature, the more motion the molecules have.

For the first time, through the use of a temperature-sensitive device, Dr. Pellam and Mr. Scott have made scientific measurements of the velocity of heat transmission at this very low temperature. This quantity is known as second sound.

This phenomenon occurs only, so far as is known, in helium at extremely low temperatures. It is the term applied to the almost magically rapid heat transfer of helium.

The controversy concerned whether there would be a rise or a fall in the speed of transmission of this second sound when the temperature was less than one and a third degrees Centigrade above absolute zero.

At room temperature, heat is transmitted when the atoms and molecules hit each other in their random motion.

This process takes time, but at temperatures near absolute zero the process is almost instantaneous.

The heat is transmitted very quickly by means of a peculiar kind of

wave motion. Because this motion is similar to that of sound waves, the process of heat transfer is called "second sound." Actually the heat transfer measured is very small, still in the region very close to absolute zero.

When the temperature rises more than two degrees above the very coldest obtainable, the phenomenon of second sound does not occur.

The characteristics of helium below two degrees above absolute zero are so remarkable that scientists have given the element a special designation, helium II. This liquid behaves so unlike any other fluid known that it is often referred to as a fourth state of matter or as the quantum fluid.

This research with helium II is expected to result in a new method of producing extremely low temperatures. The atoms of the superfluid type of helium can be separated from the normal type of atom. This is done by passing the fluid through an opening less than 1/100,000 of an inch in diameter. Only the superfluid comes through, and it does so without taking any heat energy with it. Successive passages through the extremely fine opening would separate most of the superfluid, thus allowing lower and lower temperatures to be reached.

The various designations of helium need not be confusing. The Roman numerals I. and II. refer to differences in the same isotope, ordinary helium of atomic number 2 and mass 4. The rare isotope ${}^3\text{He}$ has recently been proved not to form the unusual Helium II. state, at least at the extremely low temperatures so far reached.

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MISTRY



► SECOND SOUND in helium below 2° absolute is studied by Dr. J. R. Pellam and R. B. Scott at the National Bureau of Standards.

The Roman numerals are used to distinguish the physical states above and below the so-called "lambda (λ) point," 2.19°K . That temperature marks the critical point at which Helium I, with the properties expected of a liquefied inert gas, changes to the extreme-low-temperature state, Helium II.

The temperature of the lambda point is actually not far below helium's boiling point, and both are very close to that theoretical point called

"absolute zero," where molecular motion is expected to cease. That point is determined by projecting downward on the Centigrade temperature scale the $1/273$ rd volume shrinkage per degree observed in all "perfect" gases.

"If," reasoned the physicists of the past century, "a gas contracts $1/273$ rd of its volume for every degree its temperature falls, it should contract $273/273$ of its volume if we lower the temperature far enough, and some-

thing interesting should happen there."

The temperature -273°C . was accordingly named the Absolute Zero, and the Centigrade scale renumbered accordingly was known as the Absolute temperature scale. The same scale is now often called the Kelvin scale (K.), after William Thomson, Lord Kelvin (1824-1907), who pioneered in so much low temperature investigation.

The early researchers could foresee only a fraction of what happens near 0°K . Unexpected phenomena appeared as new ways were devised to get temperatures down nearer and nearer the theoretical limit.

The methods used for making a little volume of space colder than any thing has ever been before are very ingenious. The most commonly used refrigeration method depends on the heat transfer connected with freezing and liquefying various substances. Cooling in an old-fashioned ice chest comes about because ice takes up heat from its surroundings as it melts.

Newer mechanical refrigerators are built with a liquid-gas coolant and a closed cycle. Instead of adding to the cooling system ice that has been frozen elsewhere, they use a material which will absorb heat as it expands to the gaseous state and give up the heat again when, in another part of the system of pipes, it contracts, usually under pressure, and forms a liquid. This arrangement is often called a heat pump.

The heat pump principle can be used with different materials to produce different degrees of temperature. With such apparatus air is liquefied at

temperatures around 85°K . The oxygen liquefies at a slightly higher temperature than the nitrogen, but helium remains a gas through about eighty degrees further cooling.

Additional properties of matter connected with energy transfer have to be utilized to get temperatures down to helium's boiling point. One of these is as familiar as the cooling effect of a summer breeze. Evaporation cools the liquid surrounding the gas whose temperature is being lowered. This is usually done in double-walled vessels. For work with liquid helium a triple vessel has been devised, on the principle of three thermos bottles, one inside another. Liquid helium in the inner part is cooled by evaporation of liquid helium in the second. This, in turn, is protected from room temperature by liquid air in the outer container.

Liquid helium can be further cooled by causing it to evaporate at a lower pressure. By means of a very fast pump the vapor is removed so rapidly that a partial vacuum is created above the evaporating liquid. In this way temperatures as low as 1°K . can be obtained.

To get a further drop in temperature, an entirely different property of matter is called into use, namely magnetism. Although the effect is not usually apparent, magnetization and demagnetization are accompanied by changes in energy which can be applied to the cooling of liquid helium.

The liquid in its triple container is placed between the poles of a powerful electromagnet, and crystals of iron ammonium alum are added to the system. This salt is para-magnetic. Its

molecules line up in the magnetic field in the same way that particles of iron would. This lining up gives off heat, which is disposed of by letting it evaporate some of the helium. The magnet is then shut off, and demagnetization of the salt absorbs heat from the helium. By this means, temperatures of only a fraction of a degree on the Kelvin scale have been reached. To get temperatures below 1° K., the magnetic method is the only practical means.

It might be expected that, at this extremely low temperature, helium would behave like other substances and turn to a solid, but it does not do this at atmospheric pressure. In order to freeze it, pressure of at least 25 atmospheres must be applied.

But at 2.19° K., a temperature which can be reached by pumping alone, without the aid of magnetic cooling, helium, to the astonishment of physicists, behaves like nothing they ever saw before. The rapidly

boiling fluid at that temperature suddenly quiets down and, while it still looks like a liquid, takes on some of the properties of a gas. Notably, it loses the viscosity it had in the ordinary liquid state, giving rise to the term "superfluid." It can flow uphill and through the tiniest of openings. In this way Helium II., in the new state, can be separated from ordinary liquid Helium I. by straining it through an opening less than $1/100,000$ of an inch in diameter.

Helium II., now that it can be made and isolated for experimentation, is being studied by numerous groups of physicists. They are interested in its heat-transfer property by "second sound" waves, which Dr. Pellam and Mr. Scott have just succeeded in measuring accurately. They are interested in its use to produce electrical conductivity in certain metals at very low temperatures. Another new door has been opened to reveal a world of possibilities hitherto undreamed of.

On the Back Cover

➤ SNOWSTORM near zero is formed when air freezes over liquid helium. Strange properties of all matter at less than a degree above Lord Kelvin's absolute zero are intriguing the interest of physicists. Electrical resistance vanishes and unusual magnetic effects are found, a new kind of sound waves appear, and helium itself enters a new phase never before observed, which is neither solid, liquid nor gas. (Photographs by Fremont Davis, Science Service Staff Photographer).

Heaviest Of All Is Sixth Trans-Uranium Element

Element 98, Californium, Created

► THE 98TH and heaviest chemical element has been created through atomic bombardment in the University of California 60-inch cyclotron.

It has been christened californium, symbol Cf, honoring the university and state where the six heaviest trans-uranium elements, including plutonium, have been manufactured and discovered in the past decade.

Production of minute and fast-disappearing quantities of the new element 98 followed close upon the similar creation of element 97.

The team of scientists engaged in Atomic Energy Commission research which produced californium included Dr. Stanley G. Thompson, Kenneth Street, Jr., Albert Ghiorso, and Dr. Glenn T. Seaborg, with Dr. Joseph G. Hamilton making the bombardments with alpha particles of the isotope 242 of curium which was transmuted into the new element.

Living only a short time before it decays by emitting an alpha particle,

half of an amount of californium will disappear in 45 minutes.

The amount of californium so far made is infinitesimally small, since the bombarded curium, itself very rare, weighed only a few millionths of a gram. The identification of the new element was based on its chemical separation and its predicted half-life.

No use for the new element is suggested, except that it adds a chemical building block to the universe. It can not be used for bombs-or power.

Californium has a place in the actinide series of elements that corresponds to dysprosium, element 66, in the lanthanide series. It has been customary to name the members of the two series in a similar way. Dysprosium means "hard to get," so Dr. Seaborg, leader of the element-discovering group, explains that California was hard to get to about a century ago in the gold rush days.

Element 97 was named Berkelium, in honor of the city of Berkeley.

Pyrethrum Synthesized Commercially

► A SYNTHETIC pyrethrum chemical, with the insect killing power of the pre-DDT pyrethrum from pyrethrum flowers, has now been made on a commercially practical scale.

"Allethrin" is probably the name this new insecticide will have.

Pyrethrum-like chemicals, with the insect killing power of the plant material, were synthesized on a laboratory scale a year ago by U.S. Department of Agriculture scientists. The commercial synthesis of one of these has been made by the Union Carbide and Carbon Corporation.

**Genes Contain DNA:
Desoxypentose Nucleic Acid**

Chemical Seen as Heredity Carrier

► HEREDITY is seemingly a matter of chemistry. Prof. Arthur W. Pollister of Columbia University finds that a chemical substance within the single cell probably acts as the carrier of the hereditary units known as genes.

This chemical is desoxypentose nucleic acid, or DNA for short. Using a complex machine for photometric chemical analysis, Prof. Pollister was able to determine the relative concentrations of DNA and other substances in the nucleus of a single cell. Within this structure of a few ten-thousandths of an inch, it can be shown that the amount of DNA is less than one-trillionth of an ounce.

The genes are located in the chromosomes of the cell nucleus. Nearly every cell of the body contains at least a double set of chromosomes and a double set of genes. This double set is present because at the fertilization of the egg, two sets of chromosomes and genes were brought together, one from each parent.

By direct photometric analyses at the University's laboratories, it has been shown that DNA alone is strictly parallel in amount with the number of sets of chromosomes and genes. When analyzed, the very common double-chromosome nuclei of such cells as blood, liver, brain, kidney and glands, all were proved to have the same amount of DNA.

The single-chromosome nuclei of the sex cells, as expected, were found to have just one-half as much DNA.

And, as often happens in science as well as in other fields, the exceptions eventually helped to prove the rule: the "giant" four-chromosome nuclei, and the still rarer "super-giant" eight-chromosome nuclei turned out to have four and eight times as much DNA as the single-chromosome sex cells.

The experiments served to clear up an international disagreement over DNA. Previously, French biochemists, by comparing their analyses of DNA in masses of nuclei with the number of billions of nuclei estimated to be in the mass, found indications that the amount of DNA per nucleus might be constant, and about double that of the male cells. An American laboratory got results which did not agree with the French claims.

The direct measurements made on single cells in the Columbia laboratories clear up the dispute. They prove conclusively that the French tests are correct, and at the same time offer, in the analysis of the "giant" nuclei, an explanation of the disagreement that existed.

The project also revealed that cells may grow to eight times their usual size without any increase in the amount of DNA; that cancer cells contain the same amount of DNA as normal cells; and that human blood-forming cells always contain exactly the same kind and amount of DNA whether the cells are from infants, youths, or adults.

Hand Finishing Cast Metal Parts Eliminated By Process

Plastic Molds for Metal Casting

► A PLASTIC process makes possible the first revolution in molds for metal casting since the beginning of the iron age.

Hand finishing of cast metal machine parts is eliminated by new plastic bonded sand molds which was announced by the Bakelite Division of the Union Carbide and Carbon Corporation, at the National Plastics Exposition, Chicago.

Where formerly a wooden pattern was pressed into sand every time a casting was to be made, resulting in a rough surface which had to be worked down by hand operations, the new process gives a smooth surface and sharp corners on castings as they come from the mold. This results from mixing a small quantity of a phenolic resin with the molding sand.

The skilled craftsman, in the new process, makes the original pattern in metal. This is then coated with the resin sand mixture and baked, resulting in a thin mold which may be duplicated for as many castings as are desired. Cores for the inside of hollow pieces are formed similarly, by blowing the resin sand mixture into the crevices.

After baking, the molds are assembled, backed with lead shot to keep the halves solidly together, and filled with molten metal. New molds, each an exact duplicate of the original hand-made model, are used for each casting. Each casting comes out

smooth and ready for use. Used molds are broken up and the sand re-used.

The inventor of the process is Johannes Croning, of Hamburg, Germany, who has been in this country working on the development of the method which will be licensed by the Crown Casting Associates in Boston.

This process is unique in that it employs a heat reactive Bakelite resin binder for sand in the production of both cores and molds. Although resins have been used for many years in sand core bonding, the new method is a radical departure in that it does not require long baking and curing and uses relatively small volumes of sand.

The outstanding advantage of the casting produced with the new process is the high quality precision that is obtained. The casting comes out of the mold with clean sharp edges, true dimensions and unchilled surfaces that require little or no finishing such as sand blasting or wheel-abrading. It is said that the quality and precision of the castings are increased to the point where tolerances of from .002 to .003 of an inch per inch can be common practice. Where extremely close tolerances are required, usually only a finish cut is necessary rather than a rough cut followed by a finish cut.

An additional advantage of the Croning Process is the greatly increased productivity of the floor space.

Two-Dimensional Monolayers of Radioactive Substances

Fissionable Sheets May Power Autos

► ATOMIC engines for automobiles may be made possible by a new mechanism for the transmission of nuclear power described at the Houston Meeting of the American Chemical Society by Dr. Dietrich E. Beischer of the United States Naval School of Aviation Medicine, Pensacola, Fla.

Announcing the development of the first two-dimensional sheets of radioactive materials, called "radioactive monolayers," Dr. Beischer told how these remarkable films, which are only as thick as a single molecule, could be used as fuel for the automotive engines of tomorrow.

"In future cars a step on the accelerator may speed up the delivery band of monomolecularly distributed fissionable material to the atomic engine," he explained. "There is no more convenient way to measure and to deliver small doses of radioactive material than by areas of monomolecular films."

Dr. Beischer has succeeded in "buttering" a sheet of suitable supporting material with a coating of radioactive matter only one ten-millionth of an inch in thickness. Because the molecules in this coating are literally touching one another, with no overlapping and no holes, the monolayer forms an absolutely uniform sheet of radioactive material.

"The molecules may be compared with a crowd of people all standing upright pressed in a room and in contact with each other," Dr. Beischer

explained. "Observed from some distance, they form a homogeneous covering of the floor. Each member of this crowd can shoot in the air without hitting any other (no self-absorption in this direction)."

From a monolayer of radioactive material the radiation in a direction away from the layer would necessarily come directly from each molecule, without being reflected, absorbed, or influenced in any way by contact with other molecules. The vital significance of this fact is that the field of radioactivity in the neighborhood of a monolayer is absolutely uniform, as is the layer itself.

Atomic radiation has previously been obtained only from three-dimensional chunks of radioactive materials. Such radiation contains partially absorbed rays from the interior of the chunks. With the invention of two-dimensional monolayers, a pure radiation is possible for the first time.

Monolayers give an absolute standard of radiation, much needed in the many applications of radioactivity. A monolayer made of any given radioactive substance permits precision measurement of the radiation from the substance. And because the radiation from monolayers is dependent only on the activity of the substance and the area of the layer, any desired amount of radiation for experimental purposes can be obtained by simply cutting off the proper area of a monolayer sheet.

The speaker brought out, however, the fact that there are also many uses of monolayers of more direct interest to chemists.

Moving pictures as fascinating as rough-riding, shooting, horse-races are produced by molecules of radioactive compounds during "diffusion" tests, which are used by chemists to measure the speeds at which the molecules of different substances move under the influence of heat, said Dr. Beischer. Firing powerful shots of atomic radiation, the molecules show by means of a photographic plate how

far from the start they have advanced along a monolayer surface.

Radioautograms, or contact pictures, can be made by the use of monolayers and applied by chemists to membrane research. Shadow pictures can be made of thin specimens which are too transparent to cast an x-ray shadow. Radioactive sandwiches, or built-up films may be of scientific or practical interest.

All applications of this method depend on the peculiar arrangement of the molecules in monolayers and the radiation emitted from their elements.

Germanium Photo-Electric Eye

► A TINY DISK of the metal germanium is the heart of a new photo-electric eye.

This entirely new type of electric eye is about the size of a small caliber rifle cartridge but it delivers very high power for a photo-electric cell.

The new device from Bell Telephone Laboratories will be known as the "phototransistor" because of its relation to the amplifying transistor which also uses a tiny chip of germanium. In this parent device, two hair-thin wires are pressed against the germanium, a semi-conductor material. The ends of the wire are hardly two-thousandths of an inch apart. The flow of very small electrical currents in one of the wires controls the flow of currents in the other in such a way as to give signal amplification. The transistor is a device to replace vacuum tubes in certain usages.

The phototransistor is similar in

operation to the amplifying transistor, but is controlled by light rather than electric current. It uses only a single collector wire. The tip of this wire rests in a small dimple ground in the germanium metal. At this point the germanium is only three-thousandths of an inch thick.

Light focused on the opposite side of the disk can control the flow of electricity in the wire, thus making a control device similar in function to a photo-electric cell. It is a rugged device, without vacuum, glass envelope, grid, plate or hot cathode.

Photo-electric cells have been in use for the past quarter-century and have wide applications. Light hitting upon them results in the generation of an electric current. One use is to turn on automatically revolving lights for aviation. Approaching darkness cuts their electric production, and the reduced output current releases the revolving mechanism.

Raw Material Obtained As Sulfur Dioxide Damage Is Prevented

Save Sulfur; Solve Smog Situation

► NEW METHODS of recovering deadly sulfur from the atmosphere have begun to solve hemispheric smog problems and have added an important source of a basic raw material. Dr. Morris Katz of the Canadian Defence Research Board, Ottawa, told the Houston meeting of the American Chemical Society. Dr. Katz is attached to the Defence Research Chemical Laboratories.

The Trail smelter in Canada now produces 400,000 tons of sulfuric acid annually from the sulfur dioxide which formerly caused widespread health and property damage in both the United States and Canada. The world is still wasting more sulfur than it produces, however.

Mr. Katz said, in part:

Two major disasters involving loss of life have occurred in modern times and have been directly attributed to excessive air pollution in which sulfur dioxide and sulfuric acid mist are assumed to have played a dominant role.

In December, 1930, in the valley of the Meuse River, Belgium, seventy persons died and several hundred suffered severe respiratory disorders during a heavy fog of five days' duration. The investigating commission concluded that sulfur compounds, emitted mainly from the combustion of coal, were responsible for this disaster.

Recently, a smog disaster at two small adjacent communities, Donora and Webster, in Pennsylvania, caused

at least twenty deaths and 5,900 cases of sickness during the five-day period beginning October 27, 1948. The United States Public Health Service concluded after investigation that the casualties could have been produced by a combination of several contaminants, chief among which was sulfur dioxide and its oxidation products.

The recovery of a substantial amount of sulfur emitted to the atmosphere as sulfur dioxide and hydrogen sulfide pollutants would not only alleviate the air contamination problem, but would also provide an important new source of sulfur.

Most of the sulfur dioxide from zinc, copper, and lead smelters can be readily recovered as sulfuric acid. Hydrogen sulfide from oil and natural gas refining operations can also be recovered either as elemental sulfur or sulfuric acid. Although a great deal of the sulfur in coal will be wasted to the air for many years to come, because of economic factors, in many cases the stack gases from power plants may be utilized to recover sulfuric acid. As native sulfur deposits become depleted, the sulfur industry must turn more and more to that available from by-products, as well as pyrites.

In the smelting industry, the recovery of by-product sulfur dioxide has been closely linked with efforts to control and eliminate excessive atmospheric pollution.

About 10 to 15 per cent of the total sulfuric acid manufactured annually

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at least twenty deaths and 5,900 cases of sickness during the five-day period beginning October 27, 1948. The United States Public Health Service concluded after investigation that the casualties could have been produced by a combination of several contaminants, chief among which was sulfur dioxide and its oxidation products.

The recovery of a substantial amount of sulfur emitted to the atmosphere as sulfur dioxide and hydrogen sulfide pollutants would not only alleviate the air contamination problem, but would also provide an important new source of sulfur.

Most of the sulfur dioxide from zinc, copper, and lead smelters can be readily recovered as sulfuric acid. Hydrogen sulfide from oil and natural gas refining operations can also be recovered either as elemental sulfur or sulfuric acid. Although a great deal of the sulfur in coal will be wasted to the air for many years to come, because of economic factors, in many cases the stack gases from power plants may be utilized to recover sulfuric acid. As native sulfur deposits become depleted, the sulfur industry must turn more and more to that available from by-products, as well as pyrites.

In the smelting industry, the recovery of by-product sulfur dioxide has been closely linked with efforts to control and eliminate excessive atmospheric pollution.

About 10 to 15 per cent of the total sulfuric acid manufactured annually

in the United States represents by-product acid recovered from sulfur gases at zinc and copper smelters.

New developments of outstanding importance in the recovery of sulfur from the air are embodied in the Trail smelter's ammonia process, the dimethyl aniline process at Selby, and flash smelting at Copper Cliff in conjunction with liquid sulfur dioxide recovery.

The annual wastage of sulfur products to the atmosphere from zinc plants; lead, copper, and nickel smelters; crude oil refineries and from coal combustion have been shown to be many times greater than the present world native sulfur production, which has reached a level of five million long tons annually. This high level of production will result in rapid depletion of known deposits in salt domes which, in the United States, have an estimated life of about 25 years.

Enormous damage has been caused by the excessive sulfur emission and wastage of such products to agricultural and forest areas, and to materials such as metals, stone, cement, paint, paper, leather and textiles. The annual losses from air pollution cannot be assessed accurately but, nevertheless, amount to many millions of dollars. If one considers that a substantial portion of the sulfur dioxide or hydrogen sulfide lost to the atmosphere may be economically recovered, then the real magnitude of such losses and the importance of this problem become apparent.

Peanut meal is an excellent stock feed because modern methods of extracting the peanut oil do not destroy the protein values of the meal.

Within the last twenty years a great scientific effort has been made in the United States, Canada and elsewhere to determine the causes of air pollution and develop technical methods of control. The effect of sulfur dioxide on plant life and metabolism, photosynthesis and respiration, and the factors affecting susceptibility have been evaluated.

Considerable insight has been gained into the role of micrometeorology and the influence of topography on smog conditions accompanied by relatively high concentrations of sulfur dioxide and sulfuric acid mist. The worst fumigations have occurred during periods of temperature inversion. When there is insufficient mixing of the polluted air with fresh air by eddy-diffusion, the polluted air spreads like a cloud or blanket over the industrial area and, being unable to diffuse vertically, may be confined within certain lateral limits by the surrounding topography.

Although the effects of excessive pollution have been noted mainly on agricultural crops, other aspects have affected the public welfare more generally.

There is a great need for more research in these industries which are confronted by difficult recovery problems, for instance, the nickel smelters. Cooperation between major native sulfur producers and companies with a large sulfur problem on their hands is desirable in the interests of conservation of sulfur resources and alleviation of atmospheric pollution.

H₂S to Aid Industries of Rocky Mountain Region

Sulfur from Oil Fields

► NEW AID to industries of the Rocky Mountain region is promised by the recent discovery of a vast new reserve of hydrogen sulfide which guarantees a twenty-five-year supply of elemental sulfur.

Dr. Ralph H. Espach, petroleum engineer of the U.S. Bureau of Mines, Laramie, Wyo., reported to the Houston meeting of the American Chemical Society that a six and one-half million ton reserve, found in northern Wyoming oil fields and near the Billings, Mont., petroleum refining center, is believed capable of supporting a 500-ton daily sulfur production for a quarter century. This will provide sufficient sulfuric acid for the establishment of heavy chemical industries, such as fertilizer manufacture.

The presence of the gas hydrogen sulfide has been known since the Indians named the Shoshone River, meaning "stinking water." The hydrogen sulfide odor from the hot springs emptying into the river caused the name. The extent of the gas has been determined only in the last few years.

Other resources of the region can support industries aided by the sulfur.

Extensive deposits of phosphate-bearing rocks in Montana, Wyoming, and Utah are almost undeveloped, Dr. Espach declared. Soils in the corn-growing area of the United States are beginning to evidence phosphate defi-

ciencies, a condition that will become increasingly significant. The remedy lies in the use of phosphate on these soils.

For this purpose the phosphate deposits in these Western States will become increasingly important. The sulfuric acid used in manufacturing superphosphates and triple phosphates from these phosphate rocks has come from the copper smelting plants at Garfield, Utah, and Anaconda, Mont. Any increase in sulfuric acid requirements for manufacturing superphosphate could quite logically be supplied by acid made from hydrogen sulfide.

Chromite ores located in southern Montana contain a ratio of 1.5 to 1 chrome to iron, whereas the material used in the steel industry usually has a ratio of 3 to 1. The availability of acid in quantity is part of the answer to the processing of these chromite resources into usable material for industry.

In Wyoming and Idaho are huge reserves of vanadiferous ores and in Wyoming large quantities of titaniferous ores. If and when vanadium from these ores is needed for steel manufacture, or titanium for paints and possible other new uses, acid in quantity would be required.

Over 200 thousand barrels a day of petroleum are processed at refineries in the Rocky Mountain area and the aggregate volume of sulfuric acid in treating petroleum products from this much oil is large.

Sulfur is used in insecticides and for

soil treatment. In the Rocky Mountain area, both the spraying of plants and fruit trees and the treatment of alkaline soils are part of the agricultural picture.

Another possibility for using sulfur exists in the wood pulp and paper industry of the Pacific Northwest.

The recovery of hydrogen sulfide from petroleum deposits would bene-

fit the oil operator in several ways, Dr. Espach explained. First, the gas produced with the oil is cleaned and the petroleum returned essentially free of hydrogen sulfide. Second, the oil operator is relieved of the possibility of damage suits resulting from hydrogen sulfide damage. Third, the hydrogen sulfide is converted from a nuisance into a source of revenue.

Sulfur Safe in Fungicides

► THE SULFUR-CONTAINING fungicides widely used in agriculture are safe, Dr. M. M. Baldwin, supervisor of chemical research at the Battelle Memorial Institute, Columbus, Ohio, told the American Chemical Society of Houston. Elemental sulfur residues on food plants present no human hazards.

"The current hearings before the Food and Drug Administration relative to the need for using pesticides and the toxicological hazards of insecticide and fungicide residues are injecting a note of uncertainty in the future of some fungicides," Dr. Baldwin declared.

"However, there is no appreciable doubt that fungicides are required for the production of our food supplies, and there should be little question that elemental sulfur residues offer no health hazards."

Sulfur is one of the fundamental

elements of fungicidal materials. Dr. Baldwin cited the estimated total of 91,000 long tons of sulfur used in fungicides in the United States in 1947. Despite the increasing use of sulfur compounds in this field, elemental sulfur, one of the oldest fungicides known, remains in the dominant position, he added, noting that most of the elemental sulfur is used to combat diseases of fruit trees, particularly apple and peach trees.

Because of its low cost, elemental sulfur will be difficult to dislodge from these fields in which it is now giving quite adequate protection against fungus diseases, Dr. Baldwin said. The use of dithiocarbamates, organic compounds containing sulfur, appears to be expanding as indicated by production figures of 3,991,000 and 8,100,000 pounds for 1947 and 1948. These organic sulfur compounds appear to offer the most likely opportunity for new developments.

Asbestos mining will be undertaken near Tinaquillo, Venezuela, as soon as facilities are erected; it is expected that 500 tons of shingle and spinning fiber will be produced monthly.

Stainless steel coffee bowls, made by the spinning process, are used by the Navy.

Danger Investigations May Become Over-Industrialized

Use Analytical Chemists in Research

► SCIENTIFIC RESEARCH is becoming dangerously over-industrialized in the United States, Prof. I. M. Kolthoff of the University of Minnesota warned in the 1950 Fisher Award address at the Houston meeting of the American Chemical Society.

Continuation of this trend, he asserted, could have a disastrous effect on the national welfare, because "the country that lags behind in fundamental research is or will be lagging behind in industrial application."

Prof. Kolthoff, chief of the division of analytical chemistry at the University of Minnesota, received the \$1,000 Fisher Award in Analytical Chemistry.

Appealing for broader training and more fruitful employment of analytical chemists in the United States, Prof. Kolthoff said:

"Pure academic research, while not directed toward any practical application, is the source of applied research. History has proved over and over again that the results of academic research ultimately find practical application. It is no exaggeration to state that the country which lags behind in fundamental research is or will be lagging behind in industrial application. Viewed in this sense, the academic scientist is not only working toward the advances of his chosen field, but equally toward national and international welfare."

In its own interest, Prof. Kolthoff said, industry would do well to stimu-

late the flow of analytical papers of a fundamental nature and to recognize the analytical chemist with a Ph.D. degree as a scientist with a broad background and not a specialist in certain types of analysis.

"After 1945 it has been admitted often in this country that Europe was leading in fundamental research before the war, while we took the lead in applied research," he continued. "I am afraid that this situation will remain the same as long as we continue to treat our graduate students as school children, instead of transferring all responsibility for course work to them and requiring them to submit only once to the kind of examination that would qualify them as scientists in their chosen field."

"The major question to be settled is whether the emphasis in the education of doctorate analytical chemists should be scientific, or on the professional side. From the academic point of view the answer is simple: it should be scientific, the same as it is for other chemists."

"The death blow would be given to the science of analytical chemistry, if it ever would be decided to make the education on the Ph.D. level professional."

"The number of outstanding analytical chemists in and the output of fundamental research by industry is deplorably small as compared to the size and power of our industrial laboratories."

"If we wish to continue to encourage graduate students to major in analytical chemistry, they should have some assurance that after many years of study and research, industrial positions are available which are attractive not only from a financial view but especially from the view of scientific satisfaction they can expect to derive from their work."

Asserting that much is still to be revealed by analytical chemistry research, Dr. Kolthoff said:

"It is only in research in the fullest sense of the word that the students

show outstanding native ability, enthusiasm and critical judgment. Relatively few of the advanced students show outstanding native ability, enthusiasm, and inspired attitude for research. It is, in the first place, this small select group whom we have to cultivate, because it is they who constitute the next generation for the future advance of analytical chemistry. But also those students, less gifted by nature in creative ability and interest, can be stimulated by individual discussion of the research by meeting with smaller groups and attending the proper seminars."

Campfire Ashes Clue to Uranium

► THE PROSPECTOR's campfire will do more than keep him warm in the future. By testing the ashes scientifically, he may get a clue to gold, silver, perhaps even uranium in the area.

Two British Columbia geologists, Dr. Harry V. Warren and Robert E. Delavault, say the system for gold and silver works. Burning samples of various trees and forest plants which they cut near known gold deposits, they found measurable amounts of both precious metals.

But before you rush out to burn down the willow tree in your yard, consider the "measurable amounts"—something like one ounce of gold in 450 tons of wood, even if your house sets on a mother lode.

The relatively new science of hunting underground metals from their chemical traces in plants and trees, ground water and soil is called geochemical prospecting.

The Scandinavians made an important strike of manganese in the 1930's by using such techniques. Geologists and chemists of the U.S. Geological Survey have been working for about five years to find fast, rough tests prospectors might use in the field to unearth such metals as copper, nickel, lead and zinc. These are vital to U.S. industry.

Whether or not uranium may also be found by these methods was not disclosed by the Geological Survey scientists. But uranium is a heavy-metal cousin of gold and lead.

George Washington, in 1770, discovered bituminous coal in Virginia.

Two tons of fuel and raw material, such as limestone, are used to make one ton of cement.

**Petroleum Components
Each Pure Chemical Compound**

Dynamics of Hydrocarbon Molecules

Dr. Kenneth S. Pitzer, 36-year-old director of research of the United States Atomic Energy Commission, Washington, D.C., received the \$1,000 Precision Scientific Co. Award in Petroleum Chemistry at the Houston meeting of the American Chemical Society.

Dr. Pitzer, who is on leave of absence from the University of California faculty, was cited particularly for fundamental petroleum research which

greatly aided in the understanding of chemical reactions involving nuclear energy. Dr. Pitzer's pioneer study of the molecular reactions of the simple molecules of ethane, a petroleum product, is credited with giving science a new insight into the nuclear chemistry of complex hydrocarbon molecules.

This is a summary of his address on "Statistical Mechanics in Hydrocarbon Thermochemistry."

➤ ONCE PETROLEUM was regarded as an inseparable maze of hydrocarbons. Recently, at least the more volatile portion of petroleum has been resolved into its individual components, each a pure chemical compound. This new point of view was of major importance in the recent attainments of petroleum technology such as alkylation, catalytic cracking, etc., which greatly increased yields of high octane gasoline. However, it has required a knowledge of the various properties for roughly two hundred pure hydrocarbons to make this new era of petroleum research really effective.

There are many possible reactions converting certain of these hydrocarbons into other, more or less desirable, compounds. To determine by individual experiments which of these reactions proceed in the desired direction instead of the reverse, and at what temperatures, would be an almost impossible task. The science of thermodynamics helps considerably, but still

requires certain experimental measurements over the full temperature range for each substance.

Statistical mechanics, which is essentially thermodynamics applied to individual molecules, makes it possible to calculate the thermodynamic properties of a given hydrocarbon provided enough is known about the architecture of the molecule of that substance. The writer's program in this field started in 1936, when with J. D. Kemp, the ethane molecule was studied. It was found that the two halves (CH_3 groups) can rotate with respect to one another only if they have an energy of 0.12 electron volts. More recently it has been found that the cyclohexane ring of six carbon atoms is puckered in a regular zig-zag pattern while the two waves in a cyclopentane ring of five carbon atoms move around the ring at a speed depending on the temperature.

Data of this type have accumulated so that now the "blue prints" of the

various molecules are nearly completed. As soon as enough is known concerning a given molecule, its thermodynamic properties are calculated. When the properties have been calculated for each substance involved in a given reaction, one can further predict which way the reaction will go at any given temperature. Thus, one can tell in advance whether it will be useful to seek a catalyst for that reaction. Also, when treating a mixture of hydrocarbons one can calculate from the products which reactions were catalysed and which were not.

The present award may be interpreted as a recognition of the importance of this type of scientific attack to the petroleum chemists and technologists. While the writer's work has been done at the University of California, other groups have contributed greatly to the success of the general

program. In particular, there are the thermochemistry section at the National Bureau of Standards, under Dr. F. D. Rossini, and the group assembled by the late Dr. H. M. Huffman at the Bureau of Mines Laboratory in Bartlesville, Oklahoma. The American Petroleum Institute supported work at the University of California and at the Bureau of Standards.

An interesting byproduct of these studies arose recently when it was found that a pair of dimethylcyclohexanes were being distributed under the wrong labels. The calculated properties of one substance checked the experimental measurements on the other and vice versa. A careful search of all work on the synthesis of the compounds revealed one experiment which confirmed the decision to reverse the labels but which had been overlooked.

Fine Wire Made by Electropolishing Process

► EXTREMELY fine wire for miniature electronic equipment is being made, not by the usual drawing out process, but by chemically "eating" down larger wire to the size desired. Technically, it is an electropolishing method.

Wire less than one-tenth the thickness of a human hair has been successfully made at the Armour Research Foundation of the Illinois Institute of Technology, Chicago. Wire 0.00015 inch in diameter has been produced. The process is still in an experimental stage.

In the new method, wire is passed through a chemical bath in which an electric current is flowing. It becomes an electrode in an electropolishing bath and is dissolved away to the desired size.

Wire is normally made by drawing metal through successively smaller holes until a desired diameter is reached. The new process is chemical, not mechanical. Further research will determine how the method will work with various metals, and also just how fine a wire can be made and used practically.

A cargo of 50,000 Cuban wasps was recently flown to Mexico to help control the destructive "black flies" in fruit-producing areas.

Commercial Chemicals
"Fingerprinted" By Spectrogram

Infrared Spectrometer for Control

► A SHORT-CUT method of "fingerprinting" commercial chemicals will reveal the presence of any impurities or substituted materials. .

Dr. T. U. Marron and Dr. T. S. Chambers of the A. B. Dick Company, Chicago, Ill., reported to the Houston meeting of the American Chemical Society that the infrared spectrometer, already of great value in chemical research for identifying substances and establishing their purity, has been adapted to the manufacturing process for use in analysis of raw materials, process intermediates, and final products.

Any compound or mixture, depending on its chemical composition, will absorb certain wave lengths from a beam of infrared light. The infrared spectrometer analyzes such a beam which has passed through a sample of the compound being studied and produces a characteristic spectrogram, or fingerprint, for that compound or mixture.

Citing specific examples in the manufacture of mimeograph products, Dr. Marron described the difficulties of ordinary chemical analysis of raw materials, such as oils and other substances which are not pure compounds, but mixtures. Even after analysis, the way in which these materials behave in the production process may not be easily related to their chemical composition. However, once the material is fingerprinted by the

infrared spectrometer, any change introduced by the supplier will show up, and can consequently be related to changes in behavior during use.

Raw material selection and control become more complex with higher specialization of products, Marron stated. Costs rise and ease of procurement diminishes with the amount of tailoring operation or control required of the vendor.

Sometimes exact specifications cannot be given because of lack of knowledge about the relation of behavior and chemical analysis, he continued. In these instances, it is advantageous to relate the behavior with the spectrogram.

Sheet plastics for many uses are purchased by trade name without option to specify composition of the plasticizer, Dr. Marron said. Characteristics of the latter may be very important in certain applications, so that a method is needed to detect substitutions made by the manufacturer. In such cases, the plastic can be spectrographed quickly and the presence of an undesirable plasticizer detected.

Inks are of complex character both chemically and physically, and to the layman they are incontestable messes, yet they are scientifically compounded. By means of infrared absorption curves, within a few minutes the composition of a particular plant batch of ink has been shown to be improperly compounded by comparison with a small research batch.

For The Home Lab

Lactic Acid

by BURTON L. HAWK

➤ IN PREVIOUS ARTICLES, we have discussed the preparation of casein and lactose from milk. Now we shall investigate the formation of lactic acid which, although it does not possess any spectacular properties, is nevertheless a very important compound.

Produced

Fresh milk is very slightly acid which is due to the presence of 0.10 to 0.26 percent of lactic acid, which is not enough to worry about. However, when this milk is allowed to stand at ordinary temperatures for several days, the ever present bacteria go to work on the lactose (milk-sugar) in the milk to form a larger quantity of lactic acid. The acid then causes the familiar separation or curdling and imparts the sour odor and taste. Now about this time a strange incident occurs. The bacteria which have caused the fermentation of lactose to lactic acid suddenly become allergic to the acid produced and are unable to survive. Therefore only a certain quantity of lactic acid can be obtained. But if we add an alkali to neutralize the acid, the bacteria again become active and fermentation continues until the acidity is too great.

Prepared

So, with the above in mind, we are now ready to prepare a solution for fermentation. Mix together about 15 parts of cane sugar, 2 parts calcium carbonate, 10 parts sour milk and 50 parts water. You will notice we sub-

stituted cane sugar (sucrose) for lactose. Sucrose is similar in composition to lactose and has the same formula, $C_{12}H_{22}O_{11}$, but is different in molecular structure. Our bacteria friends do not seem to care about molecular arrangements and hence we can put them to work on the sucrose. Calcium carbonate is added as the alkalizing agent. If you wish, ordinary yellow cheese can be substituted for the sour milk; in fact, it may produce better results.

Allow the solution to stand in a warm place for several weeks, or until a quantity of small white crystals form around the inside walls of the container. These are crystals of calcium lactate. Remove them carefully, and dissolve in water, heating if necessary. Filter, and recrystallize from the filtrate by slow evaporation. Now to obtain the lactic acid, add dilute sulfuric acid to the crystals. This will produce a solution of lactic acid and calcium sulfate. To get rid of the calcium sulfate, add an equal quantity of ethyl alcohol. The sulfate, insoluble in alcohol, will precipitate and can be filtered off. Now we have a filtrate consisting of lactic acid and alcohol. To get rid of the alcohol, heat gently and it will evaporate leaving lactic acid behind. Heat until the liquid becomes syrupy and the odor of alcohol can no longer be detected.

Tested

Lactic acid is a syrupy, colorless liquid, usually with a slight sour odor.

If your acid is pale yellow, you have probably obtained the anhydride, which results from prolonged heating of the acid.

You can verify the presence of lactic acid by performing two tests.

(1) *Iodoform Reaction*. To a small quantity of lactic acid add enough dilute sodium hydroxide solution to produce a definite alkaline reaction with litmus. Then add equal quantities of potassium iodide solution and freshly prepared sodium hypochlorite solution. Almost immediately a yellow precipitate of iodoform will separate.

(2) *Ferric Chloride Test*. In this test, the lactic acid reduces the ferric ion to the ferrous state. Add dilute ferric chloride solution to lactic acid. Shake and then add a few drops of potassium ferricyanide solution. The blue color indicating the presence of the ferrous ion is obtained.

Decomposed

Lactic acid is decomposed by sulfuric acid into acetaldehyde and formic acid. You can prove this by carefully distilling a small quantity of lactic acid with twice as much 30% sul-

furic acid. Test one portion of the distillate with Tollen's solution. A bright shiny mirror of finely divided metallic silver will form on the sides of the container if acetaldehyde is present. (Tollen's Solution is made by dissolving 0.5 g. silver nitrate in 10 cc. water and adding ammonium hydroxide until the precipitate formed just barely dissolves. Add an additional 20 cc. water, and a few drops of NaOH solution.) Use immediately. Do not keep this mixture, as it deposits a black precipitate which is explosive upon standing or heating.

To another portion of the distillate, add a solution of mercuric chloride and warm. A white or grey precipitate indicates the presence of formic acid.

Used

Lactic acid is used in the manufacture of cheese, confectionery, and beverages, in dyeing baths, as a mordant, in the treating of hides, as a solvent, as a flux for solder, in medicine as a digestive, for infant feeding, in the treatment for tropical diarrhea, in dentistry for removing tartar from the teeth.

Unbalanced Equations

The Editors of CHEMISTRY are NOT Colorblind

➤ LAST MONTH we tried to be clever, and called readers' attention to the strange coincidence that the color of the cover was shocking pink, like that of the radioactivity symbol in the picture on page 6. It was a strange coincidence, indeed, for the cover was

blue-green! When the stage is all set for the Chemlins (chemical gremlins, of course), it is too much to hope that they will not step in. We *think* the cover this month is radioactivity pink, but maybe we'd better drop the whole thing.

New square milk bottles are popular because they conserve space.

Science Grows Mica Crystals

► BIGGER AND BETTER crystals of man-made mica, the mineral so critical for radio, television and other electric and electronic equipment, are being made at the National Bureau of Standards.

These synthetic crystals, superior to natural mica in resisting breakdown at high temperatures, have been grown as large as four square inches. Further improvements in the growth process will relieve the United States from depending on imports to meet requirements for the vital mineral.

Great quantities of high-grade mica are required each year in the United States, and only a small fraction of that needed is produced in this country. India and Brazil are the principal suppliers of mica for the United States.

Mica is particularly valuable for condensers, and it plays a big part in radar and other electronic equipment. Mica is rated as a strategic mineral. That is, it is being stockpiled, since there is no commercial substitute available.

Dr. Herbert Insley, Alvin Van Valkenburg and Robert Pike of the Bureau of Standards are the scientists who have succeeded in crystallizing mica in such large sheets. This is part of a broad program of fundamental research on fluorine-type artificial minerals carried on by the Bureau under the sponsorship of the Office of Naval Research. The U.S. Bureau of Mines and the Colorado School of

Mines are cooperating in the work on synthetic mica.

Making mica in the way it is made by nature would require high pressures and high temperatures. Commercial production is more convenient at normal atmospheric pressure. The scientists have succeeded in doing this, using a platinum-lined crucible.

The synthetic mica has four ingredients. Three of these are common materials sometimes used in making glass: quartz, magnesite and bauxite. The fourth, a fluorosilicate compound, is added because it acts as a crystallizing agent. This is believed to be the compound that makes this mica superior to the natural in resisting breakdown at high temperatures.

The raw mixture is placed in the platinum-lined crucible and melted in an electric furnace at a temperature of nearly 2550 degrees Fahrenheit. As the furnace cools, mica crystals grow from a tiny seed crystal at the bottom of the crucible.

Crystals free of impurities are clear and transparent, and thin flakes are easily split away along the planes of natural cleavage. Mica has a sheet-like structure and grows faster in a direction parallel to its cleavage plane than in any other direction. If a crucible with a cone-shaped bottom is used, the number of seed crystals required is reduced and the crystals tend to grow upwards.

The most satisfactory synthetic



► FLUOROSILICATE improves crystallizing quality when added to powdered quartz, magnesite and bauxite to make synthetic mica. This improvement over the naturally occurring mineral, widely used as an insulating material in electronic apparatus, was synthesized at the National Bureau of Standards.

mica developed so far has the chemical formula $K_4Mg_{12}Al_3Si_{12}O_{40}F_8$. This is equivalent to a form of natural mica in which the hydroxyl radical has been replaced by fluorine. Impurities may occur in the synthetic mica in the form of milky films parallel to the individual layers or white patches between crystals. Crystals free of impurities are clear and transparent, and thin flakes are easily split away along the planes of natural cleavage. The

synthetic form has physical properties which compare favorably with natural mica. Electrical measurements on several clear flakes, 3/4 inch square by 1/32 inch thick, indicate a dielectric constant of about 6.3. The largest crystals grown so far at the National Bureau of Standards have a surface area of 4 square inches.

Satisfactory mica synthesis depends to a large extent on the materials used in the crucible lining. Ceramic linings



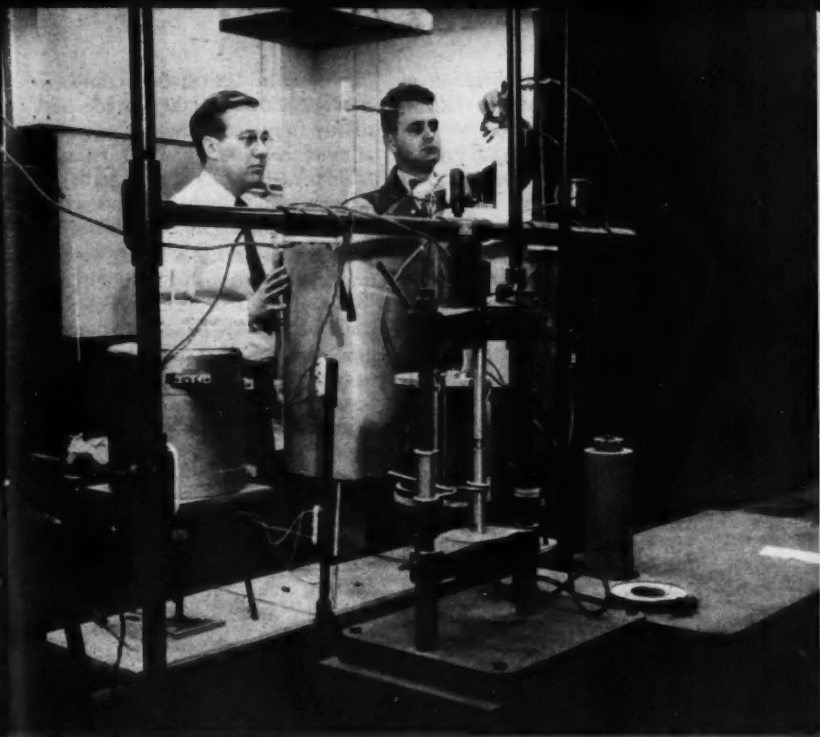
► GROWN in a cone-shaped crucible, to start growth from one centrally-placed seed crystal, the mass of crystalline material produced is separated into characteristic thin, flat sheets, sometimes as large as four square inches.



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► MELTED in this electric furnace, the raw materials for mica crystallize as they cool to form thin sheets of insulating material. (Photographs by Fremont Davis).

are badly corroded by a fluorine-bearing melt. Carbon and silicon carbide crucibles are somewhat better, but fluoride gases escape through the relatively porous walls, and fine carbon particles become imbedded throughout the synthesized mica. Crucibles lined with platinum foil give the best results. They do not react with the melt and are able to withstand high temperatures for long periods. Although initial cost is high,

the platinum linings may be melted down and re-formed again and again.

The shape of the crucible is also important in mica synthesis. Flat-bottomed crucibles are undesirable because they offer a large surface for the formation of many seed crystals which grow independently in different directions and thus limit the development of single large crystals. If a crucible with a cone-shaped bottom is used, the number of seed crys-

tals is reduced and the direction of growth tends to be upward. Experiments are now in progress to find ways of predetermining crystal growth even more completely in order to grow large parallel sheets. The key to this seems to be precise control of temperature differences in the crucible.

Mica's remarkable properties as an electrical insulator have made it invaluable to electrical and electronics industries. The United States is the world's largest consumer of natural mica, but it produces only enough to meet a third of its requirements. Dur-

ing 1948 the United States imported over 10,000 tons of high-grade mica, mostly from India and Brazil, valued at more than 15 million dollars; in the same period, domestic high-grade production totalled only 135 tons with a value of less than 50,000 dollars.

Successful control of crystal orientation in the growth of synthetic mica would mean that machine methods could be used for large-scale domestic production of sheet mica. In this way mica synthesis could make the United States self-sufficient in high-grade insulating materials.

Two New Lubricants Available

► TWO NEW synthetic lubricants were made known at the American Chemical Society meeting at Houston.

A high-quality synthetic lubricant can meet the nation's needs when the premium oil fields of Pennsylvania and the Mid-continent states run dry.

Synthetic lubricants which have antiwear action 18 times better than petroleum oil have given superior service from temperatures well below zero to 300 degrees above.

One new product is made from abundant raw materials such as coal, oil shale, and refinery by-products. It boasts "quality standards not obtainable from petroleum oils without elaborate procedures." It was described by F. M. Seger of Paulsboro, N.J., research chemist for the Socony-Vacuum Oil Company.

In this synthetic process, an intermediate chemical called 1-decene is

produced from coal or one of the other raw materials, and 1-decene in turn is converted into an excellent synthetic lubricant by a simple heat treatment in conventional refinery equipment.

Dr. W. H. Millett of the Union Carbide and Carbon Corporation, New York, described the second new series of synthetic oils, made from natural gas or petroleum hydrocarbons. It has all the other desirable qualities of high-grade lubricants, exerts a solvent and cleaning action on the gums produced by ordinary oils and can be made in water-soluble as well as insoluble form, Dr. Millett declared.

Through control of the chemical reaction by which these "polyalkylene glycol" lubricants are made, oils of any practical density can be produced, which gives them a wide range of usefulness.

Tantalum, a lustrous gray metal derived from coal-black tantalite ore, is used in the human body in surgery because it is non-irritating, malleable, ductile and resists corrosion.

Electron Acceptors Cause "Hole" in Carrier Distribution

Germanium Explains Conductivity

► GERMANIUM was famous before its discovery, as Mendeleeff's eka-silicon.

In 1882, Mendeleeff (1834-1907) was honored by the Royal Society in London. On that occasion, he drew comparisons between the properties of his predicted elements, eka-boron, eka-aluminum and eka-silicon, and those of their newly-found counterparts, gallium, scandium and germanium. For years these elements remained scientific curiosities, and little was learned about them beyond the properties described in that lecture.

Among the properties of elements which have acquired greater interest since Mendeleeff's day, one of the most important is electrical behavior. Metals are, in general, good conductors of electrical current. Non-metals are usually good insulators. The realm

between these two extremes is not as well known, and it is here that modern exploration is turning up information that is both useful and odd.

In a recent article in *Electrical Engineering*, Dr. Karl Lark-Horovitz, Head of the Physics Department of Purdue University, describes the effect of rise in temperature on germanium, as typical of semiconductors. This article is a summary of material on the nature of conductivity in semiconductors presented at the meeting of the American Institute of Electrical Engineers at Swampscott, Mass., in a symposium on electrical properties of semiconductors and the transistor. The following extract from this article gives the description of the theory of electrical behavior of germanium and similar materials.

Semi-Conductors Improve When Heated

► WHILE it is well known that the electrical conductivity of metals decreases with increasing temperature, there is a number of metallic-looking substances which show an entirely different behavior. These substances show low conductivity at low temperature, the conductivity increases as the temperature is raised, reaches a maximum, decreases again, and finally increases another time and much more sharply when a higher temperature is reached.

This behavior can be completely

understood on the assumption that the number of current carriers in these substances is dependent on temperature. These materials are called, because of their behavior, semiconductors.

At low temperatures, the number of carriers is small; ideally it should be zero at absolute zero and the semiconductor would become an insulator. As the temperature increases, a greater number of carriers becomes available by dissociation from impurity centers and the conductivity

increases. When all of the carriers from impurity centers have been released, their number remains constant until new carriers are released from another source at higher temperature. In the meantime with increasing temperature the probability of collision with the atoms present in the lattice of the semiconductor becomes more frequent, the mean free path decreases, and as a consequence the resistance increases with temperature rise.

There is, however, the possibility that at higher temperatures more electrons might be freed from the semiconductor itself and not from impurities. These so-called intrinsic electrons are available in far greater numbers than the total number of carriers which are freed from impurity centers (one per impurity center) and as a consequence the resistance at elevated temperatures decreases very rapidly. It is possible that one might find electron acceptors, instead of donors, in the semiconductor.

These acceptor impurities have the peculiar quality, not of giving off electrons with rising temperature, but of taking up electrons. As a consequence, there remains a "hole" in the electron distribution. This "hole" has the properties of a "positive" electron and an effective mass which may differ from the mass of the free electron. Thus, it is possible to create a conductor of electricity which conducts by particles which behave as free electrons, except that their effective mass may differ from the mass of the electron and that their charge is opposite in sign. Such a conductor seems to conduct by positive charges.

Silicon and germanium are elements of the fourth group of the periodic table with the same crystal structure as diamond and they have, respectively, 5.2×10^{22} and 4.5×10^{22} atoms per cubic centimeter. It has been found that the addition of impurity elements of the third group, such as boron, aluminum, gallium, and indium, give defect or *P*-type (hole) conductivity. Additions of impurity elements from the fifth group, such as nitrogen, phosphorus, antimony, and arsenic, give excess or *N*-type (electron) conductivity.

It is possible to determine the sign of the carriers in various ways. One method is to measure the transverse electromotive force produced in a material if a current flows through the material and a magnetic field is applied normal to the direction of current flow. (Hall effect).

A second simple way of determining the sign of carriers is the determination of the sign of the thermoelectric power, and finally, a third method is by observation of the direction of rectification, which usually can be predicted . . . a *P*-type semiconductor in contact with a metal electrode will have a current flow in the opposite direction from the one observed in an *N*-type or electron-carrying semiconductor. . . .

Because of the small number of intrinsic carriers at room temperature, addition of impurities even of the order of 10^{-2} to 10^{-6} per cent by weight can change the conductivity of a semiconductor in a measurable and reproducible way. It is not possible to determine quantitatively the distribu-

tion of such small amounts of impurities by ordinary chemical or spectrochemical methods. In the case of aluminum special spectroscopic methods have been used. However, it is possible to use radio-active isotopes of suitable impurities, such as phosphorus and antimony, and to study the distribution of the solute with a Geiger counter.

By using the radioactive isotope of antimony (Sb^{124}) such experiments can be carried out. The amounts of antimony added to germanium were 0.054, 0.0081, and 0.00078 per cent. Radioautographs indicate that the antimony concentration varies exponentially with the depth in the ingot, being greatest at the top, which was the last portion to freeze. Geiger counter measurements on specimens from various positions, give a quantitative analysis of the antimony distribution. Hall effect measurements on the same specimens show that in the saturation region of the impurity range each antimony atom produces one conduction electron.

Having correlated the Geiger counter and Hall-effect measurements, one is justified in determining the concentration of impurities in non-radioactive ingots from the flat portion of the Hall curve. As an example, Hall effect measurements on an *N*-type high back voltage germanium ingot to which no impurity had been deliberately added show an excess of 1.8×10^{14} per cubic centimeter donor or over acceptor impurity atoms at the bottom of the melt compared with 1×10^{15} per cubic centimeter near the top of the melt. Moreover, if the mobility is not appreciably affect-

ed by impurity scattering, it is possible to use resistivity measurements at room temperature as an analytical method for determining the quantity of antimony in germanium alloys.

The preparation of semiconductors with definite predictable properties based upon the addition of impurity atoms would be "ideal" if the new atoms could be placed at the lattice sites occupied by the original atoms, without disturbing the rest of the material. In principle this can be accomplished by exposing pure semiconductors to slow (thermal) neutrons, which are absorbed with the emission of gamma rays and produce radioactive nuclei, which disintegrate, leaving stable new atoms in place of the original semiconductor atoms and their isotopes. In the case of germanium the number and type of isotopes is quite well known, and it is also known that transmutation can lead to the formation of new atoms, namely gallium, which will produce *P*-type conduction, and arsenic, which will produce *N*-type conduction.

The balance between the two types of new impurity centers produced will be the factor to determine whether the final material will conduct by holes or electrons. The answer as to which one of these processes will predominate is determined by the efficiency with which the target nuclei interact with the nucleons.

An interesting result of the great difference in conductivity produced in germanium by the presence of only a few atoms of any impurity is described in the following article written by Dr. Lark-Horovitz especially for CHEMISTRY.

One in a Hundred Million Atoms
Accuracy in Germanium Measurements

Conductivity Spots Impurities

by DR. KARL LARK-HOROVITZ

Head, Department of Physics, Purdue University

► ONE OF THE interesting features of studying semiconductors is the very great sensitivity of the material to the presence of minute amounts of impurities. A chemist would consider any material which contains less than one impurity atom in a thousand atoms pure. Actually, we are able, by means of electrical measurements, to detect in the case of germanium an impurity which is present in only one part in a hundred million. It is as though there were a lottery in the United States and all living persons in the country participated, then only one person out of the whole population could get the coveted prize, an impurity atom, all the others would get ordinary atoms of the pure substance.

This fact makes it possible, first of all, to design at will conductors of electricity which can vary over a very wide range of conductivity. For instance, the purest germanium which can be made will always have, at room temperature, a conductivity such that a cube of the material one cm. on edge would have a resistance of 60 ohms. In the case of silicon, the purest material, which so far has never been made, would have for a similar cube 270,000 ohms resistance, and a cube of tellurium would have a resistance of just one ohm. To these three figures correspond a certain

number of impurities or electrons which have been released from the material itself, and these are, in the case of tellurium, about 10^{16} per cubic centimeter; in the case of germanium, 10^{14} ; and in the case of silicon, 10^{12} . Therefore, by introducing impurities, it is possible, for instance, to prepare silicon with resistivities ranging from 0.0001 ohm centimeter, which is a good conductor, to 270,000 ohm centimeters, which has a very-low conductivity indeed. In the case of germanium, the range would extend from the same lower limit to about 60; in the case of tellurium, also from the same lower limit to about one ohm centimeter.

But this is not all; if one really knows the number of impurity atoms which can be ionized, then the measurement of resistivity is an ideal method of detecting small amounts of impurities. However, one always has to keep in mind that only the impurities which contribute to the electrical conductivity can be found in this way. We have shown that with melting which is not particularly carefully done, there may be as many as a hundred times the number of impurities present, and only one out of this hundred will actually contribute to the conductivity. Where are these additional impurities located? They are perhaps at grain boundaries. They

may be distributed in such a way that they cannot be ionized, and therefore will not contribute to the conductivity. You will ask the question, how can one find even the number which will correspond to one in a million? That can be done nowadays by using radioactive indicators to trace the impurity elements through the material. During the war we used radioactive phosphorus for this purpose. At the University of Pennsylvania they have used radioactive aluminum. Recently at Bell Telephone Laboratories, they have been using radioactive antimony for the same purpose. In this way one can establish how far the material is homogeneously and ionizably introduced into the semiconductor.

The interesting thing is that it is possible nowadays with proper purification techniques to make pure germanium or tellurium day in and day out. And the question, of course, is why is it possible to do that? It so happens that molten germanium behaves somewhat like mercury, which means it does not wet the walls of the vessel in which it is solidified. And if it is solidified in a very high vacuum so that it has no chance of picking up either nitrogen or oxygen, then we do get this pure material, and get it by routine operation. In the case of silicon it is much more difficult to achieve high purity material because it is a material that melts at a much higher temperature and also a material which wets the walls of the vessel in which it is molten and consequently includes impurities due to the interaction with the walls of the vessel.

Where is the germanium coming from? Most of the germanium comes from lead and zinc ore. The germanium which is being used nowadays in the United States is almost all from Eagle Picher, a company in Joplin, Missouri. During the war when the demand for germanium first developed due to these researches, germanium came out of the fraction from which indium was prepared. Formerly the germanium residue had no value, but since the development of uses for germanium, the price of indium has fallen.

At the present time the demand for germanium has increased to such an extent that companies have to go back to the ore and now purify the ore, and as a consequence the price of germanium has gone up again. However, before the war germanium was such a rare material that even the complete line spectrum was not known. The melting point is still somewhat in dispute. Nowadays germanium is produced at the rate of about 180 pounds of the oxide per month, and if necessary the production could be stepped up again. It becomes clear, however, what a rare material it is if one considers that only two ounces of germanium are extracted in 18,000 tons of original ore. This shows that very delicate techniques in the refining methods are necessary to make material which then can be brought to such purification by proper techniques in the research laboratory.

We have demonstrated in this material the very high sensitivity to small impurities and also the effect of small impurities on electric properties. This

is something which one finds also in an entirely different field of physics, namely, in biophysics. There also extremely small amounts of material may have some profound effects. The question is, how far can the techniques which have been developed in the study of solid state in inorganic matter be transferred to the theory and practice of the solid state in organic matter, and finally to the understanding of very large organic molecules such as we find in the proteins? This leads us to the physics of the future, which will develop the electronics in the living body.

This is still a long way off. But one will first have to develop the solid state physics of organic crystals. In the organic scintillation counter, for instance, there are light flashes, scintillations which are produced by the excitation of electrons which are lifted to higher energy states and when returning to the original state cause light emission. In such materials as naphthalene and anthracene, one finds that the spectra of such materials when excited to fluorescence are molecular spectra. They are similar to the spectra obtained in solution or in the vapor phase, which means this type of scintillation counter, the organic scintillation counter, is com-

pletely different from such scintillation counters as zinc sulfide and diamond. There you actually lift an electron from a full band into a conduction band and when it falls back, it produces this peculiar flashing, the scintillations, which are *characteristic of the crystal*. Scintillations in anthracene and such substances are *characteristic of the molecule*. Now the question is, how does this problem fit into the electronics of organic substances?

We found that if anthracene is not completely pure, there is seen upon irradiation the spectrum in the spectrograph, but the crystal does not "count" any more. Then we found another thing: Every scintillation counter which we had investigated at Purdue also can act as a crystal or conductivity counter. That means there are really conduction bands also in the organic crystal, and so what happens is this: An electron is lifted into the conduction band, also in anthracene, but when it falls back, it excites the molecule. The question of how energy is transported in complex organic substances and how it is transported into the molecules which make up living matter is the problem of the electronics of the future.

Jet Fuel From Oil Shale

➤ BILLIONS of barrels of jet engine fuel, for possible wartime emergency, can be extracted from the oil shales of Colorado, Dr. J. D. Lankford of the U.S. Bureau of Mines told the Houston meeting of the A.C.S.

He estimated that 88% of the crude oil could be converted into a hydrogenated product containing a premium diesel oil and a high-quality jet fuel practically free of sulfur, oxygen and nitrogen compounds.

Radiation Locates All Products Of Cancer-Inducing Chemical

Radioactivity Traces Carcinogen

► RADIOACTIVE TECHNIQUES now permit chemists, for the first time, to trace all parts of a cancer-forming chemical through body processes, Dr. John H. Weisburger of the National Cancer Institute, Bethesda, Md., told the American Chemical Society at its Philadelphia meeting. This achievement may make possible identification of the specific part of the compound which causes cancer.

Many chemical compounds which are foreign to the body are known to incite cancer in both animals and human beings, Dr. Weisburger said. These compounds are called carcinogens.

Describing research on a particular carcinogen, Dr. Weisburger continued: "It was of considerable importance to find out why 2-acetylaminofluorene caused tumors, because this could provide more definite ideas about how and why cancer develops. In order to gain insight into this problem it was necessary to get some information on the fate of the compound after its administration to experimental animals.

"It seemed that the use of modern radioactive tracer techniques might offer a solution to the problem. It was decided to label important points of the molecule of the carcinogen with radioactive carbon so that all the compound could be traced through an animal and thus be accounted for.

In contrast to previous techniques, which accounted for less than a third of the cancer-inducing material and its products, the new method traced and recovered the full amount."

The experiments were carried out by administering the carcinogen to a healthy young rat by stomach tube. The test animal was kept in a "metabolism cage" so that excretions, and even respired air, could be tested for radioactivity by the use of delicate Geiger counters. After the tests were completed, the rats were anesthetized and killed by withdrawing blood from the heart. All important organs and tissues were dissected, and analyzed for radioactivity. Simple calculations showed how much of the tagged portion of the carcinogen was present in the organ, and when total radioactivity in all parts was added up, nearly 100 per cent was recovered. Hence, the studies apparently gave an accurate picture of the distribution of the carcinogen or its breakdown products in rats, Dr. Weisburger declared.

It was interesting to observe that when one part of the carcinogen molecule was labelled, nearly all the radioactivity was recovered in the excretions, whereas when another part of the molecule was tagged the expired breath of the animal became radioactive, showing that that particular part of the compound went into the formation of carbon dioxide.

**Practical Use of Antibiotic
Possible in Meat Production**

Aureomycin Helps Animal Growth

► THE DISCOVERY that the golden-colored drug aureomycin is a potent growth accelerator, producing effects beyond those obtainable with any known vitamin, was announced at the Philadelphia meeting of the American Chemical Society.

Animal experiments cast the antibiotic in a spectacular new role. It may have enormous long-range significance for the survival of the human race in a world of dwindling resources and expanding populations. Aureomycin increased the rate of growth of hogs by as much as 50 per cent, in experiments by Dr. E. L. R. Stokstad and Dr. T. H. Jukes of the Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

Although aureomycin's hitherto unsuspected nutritional powers promise to be of importance primarily in extending the world's meat supply and decreasing its production costs, they may also prove directly beneficial to human health by aiding the growth of malnourished and undersized children. Clinical investigations of this possibility are now under way.

Up to now aureomycin, like penicillin, streptomycin, and the other antibiotic wonder drugs, has been regarded solely as a weapon for fighting disease. Aureomycin has been found particularly useful against such ailments as virus pneumonia, whooping

cough, Rocky Mountain spotted fever, undulant fever, typhus, eye infections, amebic dysentery, streptococcus and staphylococcus infections, and parrot fever.

The Lederle chemists stumbled upon aureomycin's growth-promoting value in the course of research on vitamin B-12, another powerful growth stimulator.

Chicks and turkey poults as well as pigs have registered unprecedented gains upon receiving minute quantities of the drug in the form of a finely ground powder mixed with their feed.

In fact, in the experiments conducted so far, aureomycin has been found to produce a growth response that cannot be duplicated by any of the vitamins known at the present time even when added in many times the normal requirement. No undesirable side effects have been observed, it is said.

Aureomycin, which was first isolated about four years ago by Dr. B. M. Duggar of the Lederle Laboratories, and which derives its name from its golden color is the first antibiotic to be used to promote growth in farm animals, although laboratory tests of the nutritional value of some other antibiotics have been made.

Just how aureomycin works in speeding growth is something Dr. Stokstad and Dr. Jukes have yet to

determine. Since other antibacterial agents with widely differing chemical structures can produce similar though less dramatic results it seems unlikely that aureomycin functions as a vitamin.

It is more probable that it inhibits growth of certain detrimental microorganisms in the intestinal tract. These bacteria may rob the intestine of some unknown vitamin, or they may produce a toxic compound.

The value of animal protein products as supplements to vegetable protein rations has been known for some time. More recently it has been found that the activity of these animal protein supplements is due to a vitamin which has been designated the animal protein factor, often called APF, and which includes vitamin B-12.

Aureomycin, like penicillin and streptomycin, is obtained from a mold by fermentation. Fermentation products used in the preparation of antibiotics were found to contain vitamin B-12, and these materials were developed as commercial sources of the animal protein factor for the feed industry. It was observed at the Lederle Laboratories that such a product prepared from the aureomycin fermentation gave a growth response with chicks which was greater than that which could be obtained with pure vitamin B-12. This precipitated a coast-to-coast series of experiments.

Workers at Washington State College and at the University of Connecticut found that vitamin B-12 supplements produced no growth response in turkeys, while an animal protein factor supplement made from an aureomycin fermentation prod-

uct produced a marked increase in growth.

Similar results had been observed with pigs at the University of Florida. Thus, results had been obtained with chicks, turkeys, and pigs which showed that the aureomycin fermentation contained another growth factor in addition to vitamin B-12. This second growth factor does not occur to any appreciable extent in natural feedstuffs, with the possible exception of fish meal. This second growth factor is the antibiotic aureomycin.

The amount of aureomycin needed to produce a response is small, it is emphasized. Twelve milligrams—or about four ten-thousandths of an ounce—per pound give a marked response.

The cost of adding aureomycin to feedstuffs is not great, since the fermentation product used need not be purified. This product sells for 30 to 40 cents a pound, and about five pounds of the product is enough to mix with a ton of feed. Pure aureomycin was employed in the tests which established the drug's role in nutrition.

Inclusion of aureomycin in a ration reduces the requirement for vitamin B-12 by 50 per cent. This explains in part the fact that animal protein factor supplements from aureomycin fermentation products apparently contain more vitamin B-12 as measured by chick assay than as measured by microbiological assay.

Under commercial practice, animals may obtain vitamin B-12 from the soil or from floor litter. Bacterial fermentation occurring in the chicken droppings and the floor litter produces vita-

min B-12 which the chickens pick up along with their feed. Under such conditions chickens apparently may not need additional quantities of vitamin B-12, but they are still benefited by aureomycin-containing materials.

The use of feeding supplements containing aureomycin promises to give faster growth than has been obtained on many diets of natural ingredients.

Clots Blood in Body; Prevents It in Bank

➤ SAFER and easier blood transfusions are promised by a new chemical that raises the blood's clotting power in the body but has the opposite effect on blood stored outside the body.

The compound, ethylene bis-iminodiacetic acid, was investigated originally as an anticoagulant by Dr. Gustav J. Martin, Vinton Swayne and Robert Brendel of the National Drug Company, Philadelphia. It soon became apparent, they reported to the American Chemical Society at Philadelphia, that addition of a minute quantity of the chemical to blood would completely prevent clotting—in the test tube.

In the body, however, instead of the expected anticoagulant effect the chemical was found to increase the blood's tendency to clot. This would eliminate the compound from consideration as an anticoagulant, but it appears as the ideal material for transfusion.

Ramie fiber, which grows in South America as well as in the Far East, is used by the Japanese for fishing nets because it is not injured by sea water.

This increase in growth has been observed in chickens, turkeys, and pigs. The use of aureomycin as a feed supplement is not limited to vegetable protein rations. It produces an increase in growth when added to diets containing animal proteins as well as when added to all-vegetable protein diets. This promises to give more efficient utilization of feed and to decrease the cost of meat production.

The ethylene bis-iminodiacetic acid would prevent clotting of the blood in vitro, which would facilitate storage and handling. On injection of the blood the chemical would cause an increased tendency for the blood to clot—a desirable aspect, inasmuch as patients receiving transfusions are often in a state of shock due to excessive hemorrhage.

The compound belongs to the group known as sequestering agents, which have found wide application in industry, for example, in the production of liquid soaps. Many samples of water contain calcium, which will react with ordinary soaps to form precipitates, such as the ring around the bathtub. If a sequestering agent is added to the soap, it will prevent the calcium from causing this effect.

Sequestering agents also are valuable in the textile industry, in the clarification of wines, and in the formulation of cold rubber.

Survey of Central American Plants Finds Unused Nutrition Sources

Common Weeds Found Good Food

A long untapped food source in Central America, provided by common weeds and a variety of other edible plants, has been uncovered in a three-year survey conducted by the Nutritional Biochemistry Laboratories of the Massachusetts Institute of Technology.

More than 200 kinds of food from plants, collected in Honduras, Guatemala, El Salvador, Costa Rica, Nicaragua, and Panama were analyzed at M.I.T. during the survey, according to a report to the Philadelphia meeting of the American Chemical Society by Dr. Hazell E. Munsell, Dr. Louis O. Williams, Louise P. Guild, Lucille T. Kelley, Ann M. McNally and Dr. Robert S. Harris.

Three weeds showed up as important potential foods were blede extranjero, or lambsquarters; chipilin; and macuy, or mora.

All three gave high values for calcium, iron, the B-vitamins thiamine and riboflavin, and ascorbic acid, or vitamin C, and the first two also had sizable contents of carotene, from which vitamin A is obtained, and niacin, another B-vitamin.

Chaya, the leaves from an ornamental tree, is not known to be used as food in Honduras, where it was obtained, but it is edible and gave very high values for calcium, iron, carotene, riboflavin, niacin, and ascorbic acid. Tampala, one of the pig-

weeds, is used as a cooked vegetable. The sample gave high values for calcium, iron, carotene, riboflavin, niacin, and ascorbic acid.

Leaves of the cassava, hojas de yuca, may be eaten after cooking, although they are not known to be used as food. The nine samples examined gave high values for calcium, iron, thiamine, riboflavin, niacin, and ascorbic acid.

An aquatic herb called *Jussiaea repens*, taken from the Rio Yeguaré in Honduras, is another valuable food not used at present.

The growing points and tender leaves of squash and pumpkin vines are eaten commonly in Central America. Samples studied contained plenty of calcium, iron, carotene, thiamine, riboflavin, niacin, and ascorbic acid. Highly prized as food are the flowers of the yucca plant, which are rich in thiamine, riboflavin and niacin, and particularly ascorbic acid. Yucca hearts also are eaten, providing valuable sources of calcium.

Motate represents the tender edible leaf bases of a shrub used as hedges and found growing abundantly throughout Central America, although used commonly as food only in El Salvador. It showed a relatively high content of calcium.

Likewise rich in calcium are the flowers of palms, or pacaya, which are popular as food in Guatemala.

A Dr. Jekyll-Mr. Hyde sort of plant is the Marva parviflora, which is sometimes eaten in Guatemala but which can be a very troublesome weed in cultivated areas. The plant, a native of Europe, has a large content of calcium, iron, carotene, thiamine, riboflavin, niacin, and ascorbic acid, indicating that it might be advantageous to make more extensive use of it as food.

Among the Costa Rican plants studied, most of them from the San Jose area, were the abundant puntas de chayote, or growing ends of chayote, which proved rich in iron, carotene, thiamine, riboflavin, and niacin.

Analyses were made with nineteen samples of beans, varying in size from the very tiny rice bean, frijol de arroz,

to the large red bean, frijol guaria; in color from white to blood red, and of many shapes. The outstanding feature, with one or two exceptions, was their remarkable similarity in composition. The rice bean showed the greatest difference in its very high content of calcium.

Analysis of parsley, focused attention on this food as a source of calcium, iron, thiamine, riboflavin, niacin, and ascorbic acid, indicating that it should be eaten and not used merely as decoration for some other usually less valuable food.

Kafir corn, or maiz de Guinea, is an excellent source of niacin and several other nutrients, and is therefore a cereal worthy of consideration.

Chemists to Outdo Nature's Drugs

► CHEMISTS will outdo nature in production of wonder drugs a decade hence. They will manufacture artificially better disease treatments than mold-produced penicillin and other antibiotics.

This is one prediction by Dr. Theodor Wagner-Jauregg, German chemist now with the medical division of the U.S. Army Chemical Center at Edgewood, Md.

Dr. Wagner-Jauregg is the son of Dr. Julius Wagner-Jauregg who in 1927 was awarded the Nobel Prize in medicine for his discovery that the fever of malaria could be used to cure syphilis of the brain and central nervous system (paresis).

"Nitramine," a chemical made in Germany during the war, Dr. Theodor Wagner-Jauregg said, is chemical-

ly related to chloromycetin, one of the Big Four mold remedies or antibiotics.

This suggests that other chemical relatives of chloromycetin should be synthesized in the search for better chemical remedies.

The situation in this field is about the same as it was with quinine some decades ago, he believes. No other remedies for malaria were known in earlier times. Today we have several synthetic compounds not only equivalent to the natural drug but even better in some respects.

For the more complicated antibiotics, like penicillin or streptomycin, chemists hope to find synthetic substitutes, at least for some of their functions.

Rubber Theory Revised Mixing Techniques Improved

Better Understanding Helps Rubber

► AN ENTIRELY new concept of the role carbon black in rubber processing, which promises a significant improvement in the quality of tires and other rubber goods, was announced to the American Chemical Society at its Detroit meeting.

The new theory, outlined in a paper by Dr. R. S. Stearns and Dr. B. L. Johnson of the Firestone Tire & Rubber Company, Akron, Ohio, explains the toughening effect of carbon black on rubber in chemical rather than physical terms, and thus upsets the view which has prevailed among rubber technologists for many years.

In the light of this new explanation, the paper said, a more nearly complete understanding of the way in which today's finely divided materials strengthen and reinforce rubber has been obtained, and further research along these lines should lead to the production of materials which will make the quality of tires and rubber goods still better tomorrow.

The submicroscopic particles of carbon black which are added to rubber in the manufacture of tires and many other rubber products are not tiny, inert particles of carbon, as they have long been pictured, but should be considered as large molecules with reactive carbon atoms on their surfaces similar to the reactive carbon atoms of rubber, the report explained.

The existence of these active groups enables the carbon black to take part

in the vulcanization reaction, the last step in the production of tires and most other rubber articles, and to combine chemically with the rubber, becoming in actuality a part of the rubber itself. The vulcanization reaction takes place through the use of heat in the presence of sulfur.

Carbon black, a soot-like material, was first added to rubber by Charles Goodyear about 1855, mostly to serve as a filler and to decrease the cost of the final product. It was soon realized, however, that the carbon black played a more important role than that of a dilutant, for it was observed that when carbon black was present many of the physical properties of the rubber were enhanced.

It has since been used to increase the life expectancy of automobile tires to more than 30,000 miles and has improved the strength, durability, and "bounce" of rubber products in thousands of other applications. This effect has been described by rubber chemists as reinforcement. Up to now, they have been unable to explain how an "inert" material like carbon black could accomplish this gratifying transformation.

Although much research has been done and considerable progress has been made in understanding the mechanism by which finely divided materials such as carbon black reinforce rubber, there have been no satisfactory theories advanced as to why

some carbon blacks are superior reinforcing agents while others having similar and in some cases equal physical properties, such as total surface and particle size, are unsatisfactory.

It was in an effort to gain a better understanding of the mechanics of reinforcement, and in particular to determine whether the interaction between the polymer and the surface of the solid inclusion was chemical or physical that this research was inaugurated.

Research has demonstrated the presence of active groups on the surface of carbon black particles, making it possible for these particles to become bound to the rubber through carbon-sulfur bonds in the same manner in which the sulfur reacts with rubber to bring about the familiar improvement in properties which accompanies vulcanization. It is in the ability of the carbon black to react chemically with the polymer during vulcanization that the answer to the mechanism of reinforcement lies, the paper said.

It is now possible, in addition to controlling the surface area and size of carbon black particles, to control the chemical nature of the surface. Thus, certain blacks are indicated to have, in addition to the physical adsorptive forces, greater degrees of chemical activity which enhance the value of rubber products in which they are contained.

Electrically Conductive

➤ CLEARER radio reception in moving automobiles, elimination of annoying shocks from touching charged objects, and fewer industrial accidents caused

by sparks will result from new development in rubber compositions which will conduct electricity, according to L. R. Sperberg, G. E. Popp, and C. C. Biard of the Phillips Petroleum Company, Bartlesville, Oklahoma.

Electrostatic discharges from rubber conveyor belts, rubber floors, and rubber-tired vehicles can be minimized or eliminated by the use of electrically conductive rubbers, these chemists told the American Chemical Society at Detroit.

The deterioration of automobile inner tubes in some instances is believed to be caused by electrical discharges from tires and the inner tube might actually be punctured as a result of electrical discharge.

Results of tests indicate that in the preparation of rubber compositions, the length of time spent in milling is in some cases much more important than was previously believed. Excessive mixing, in some instances, transforms an electrically conductive rubber into an insulating material.

The various types of synthetic rubber were compared with natural rubber in laboratory tests. Butyl rubber was found to impart excellent conductivity characteristics when the proper type of carbon black was used in the composition. Such a composition should reduce the accumulation of static charge on vehicles equipped with butyl rubber inner tubes, it was indicated.

The popular conception among rubber technologists, that the repeated flexing or bending of rubber articles will lower their conductivity, was not confirmed in the tests, the report

stated. Flexing may reduce the conductivity slightly, but the magnitude of the decrease is much less than would be anticipated on the basis of previous theories.

At least 10 per cent of carbon black must, apparently, be used in rubber to obtain a conductive composition. Larger amounts of carbon black improve the conductivity and decrease the variations in the product due to differences in production procedures.

Masterbatching for Tires

➤ LONGER LIFE for automobile tires has been assured by recent advances in the blending of cold rubber and chemicals, three United States Rubber Company chemists reported to the same meeting. James W. Adams, W. Earl Messer, and Louis H. Howland of the company's Synthetic Rubber Division at Naugatuck, Conn., described what they termed the first successful blending of new high abrasion carbon blacks and cold synthetic rubber in latex or liquid form.

The process, which is known as masterbatching, is now being used to produce rubber for tire treads at the synthetic rubber plant operated by U. S. Rubber at Borger, Tex.

The usual method of blending carbon black, a valuable reinforcing agent, and rubber is to mix them dry in powerful masticating equipment. The masterbatch process consists of blending carbon black in water with rubber in a latex form. The compound is then changed with salt and acid solutions to a dry rubber, already containing the necessary amount of carbon black.

Natural rubber has been compounded almost exclusively by the dry-mix method. Synthetic rubber, however, is well suited to the masterbatching technique.

By supplying rubber goods manufacturers with synthetic rubber and carbon black pre-mixes, it has been possible to improve product quality, to reduce greatly milling and blending time and to maintain cleaner fabricating plants.

Almost any variety of general purpose synthetic rubber, known as GR-S, has been readily adaptable to the masterbatch process and considerable progress has been made in masterbatch techniques.

It was only recently, however, that it was possible to blend the newer types of carbon blacks, known as high abrasion furnace blacks, with cold rubber. This technique is now being used in full scale production at the Borger plant.

Information now available indicates that automobile tire treads made from latex masterbatched GR-S will wear 1,500 to 2,000 miles longer than similar tires made from dry-mixed carbon black GR-S compounds, the report said. This represents approximately 7 per cent more tire wear, based on an average tire life of from 20,000 to 30,000 miles.

The paper also held out hope for further improvement in tire tread wear through a new technique of blending carbon black and synthetic rubber known as high speed homogenization. This development however is still in the laboratory stage.

New Methods in Chemical Fields

To obtain any patent, order by number from the Commissioner of Patents, Washington 25, D. C., enclosing 25 cents in cash, money order or Patent Office coupon, but not stamps, for each one.

► WIDER USE of soybean as a food is promised with a vegetable gel which contains the protein content of the bean in gelling constituents from which foods containing meat or puddings may be prepared easily and simply.

The patent covers both the vegetable gel and the process by which it is obtained. Its number is 2,495,706. Recipients were Letta I. De Voss and Arthur C. Beckel, of Peoria, and Paul A. Belter, Pekin, Ill. Rights are assigned to the U. S. Department of Agriculture and the gel may be made by the government in any part of the world without the payment of royalties.

In general, the process involves providing an alcohol-extracted proteinaceous soybean residue free of alcohol-soluble matter. Water is used to extract a sufficient quantity of this residue. Fibrous, insoluble soybean material is removed, then the mixture is spray-dried to a solid, powdery material.

Copper on Aluminum

► TWO RECENT patents are of special interest to metal users. One is a process of electroplating copper on aluminum. The other is a method for

deoxidizing iron and steel in the manufacturing process.

Patent 2,495,941 was issued to Lucio F. Mondolfo, Sea Cliff, N. Y., for the first. It has been assigned to the Reynolds Metal Co., Richmond, Va. Patent 2,496,074 was granted on the iron deoxidizing process to James C. Vignos, Canton, Ohio. Patent rights are assigned to Ohio Ferro Alloys Corporation of the same city.

In the copper-on-aluminum process, two aluminum articles are immersed in a water solution of sulfuric acid and copper sulfate, and an alternating current is applied to the two articles as anodes. Thus they receive an anodic coating. The articles are then connected in parallel as cathodes and a body of copper is used as an anode. Direct current is used to deposit copper on the articles.

In the manufacture of killed steel, and where blocking of the heat in the furnace is required, it is customary to stop the action of the bath by the addition of 10% to 14% ferro-silicon. Impurities result. In the improved process, lumps of 50% ferro-silicon one inch in thickness or larger are used. These lumps are treated with a wetting agent such as sodium nitrate or peroxides or other compounds having available free oxygen. The result is a purer product.

Small Mercury Turbine

► AN IMPROVED small mercury vapor turbine and electrical generator, with-

in a single sealed enclosure, brought Charles V. Litton, Redwood City, Calif., patent 2,495,745. It has been assigned to Federal Telephone and Radio Corporation, New York City.

It is a gas turbine engine in which mercury vapor is used for the gas. By a special pumping device, an important part of the invention, condensed mercury is returned to the boiler for re-use. The turbine shaft is vertically positioned, which results in a minimum of frictional resistance at an upper aligning bearing. The entire weight of the rotor is carried by a lower thrust bearing.

Oxide Coat on Aluminum

➤ AN IMPROVED method of rendering oxide coatings on aluminum more adsorptive, especially with respect to dyes, earned Walter G. Zelle, New Kensington, Pa., patent 2,496,649. The patent has been assigned to Aluminum Corporation of America, Pittsburgh, Pa.

Electrolytically produced oxide coatings on aluminum are adsorptive and easily dyed or otherwise colored, but the operation is expensive. Most chemically produced coatings are less satisfactory. The process for which the patent was issued is an improved chemical treatment.

In his process, a chemical coating is formed by ordinary methods. The coated article is then immersed in a hot aqueous solution containing an ammonium compound. The result is a coating on the aluminum which will take coloring in a satisfactory manner.

Ethyl Lead Scavenger

➤ BETTER antiknock mixtures for gas-

oline engines are promised in patent 2,496,983, on which patent rights have been acquired by the Ethyl Corporation of New York City, the recipient being George Calingaert of Detroit. The improvement is in the so-called scavenger used with lead antiknock compounds.

These scavengers are essential. They are materials used in the mixture to produce, during combustion, volatile lead compounds which are exhausted from the engine. The scavenger covered by the patent is a mixture of a bromoether with a chloro-scavenger or a chloroether with a bromo-scavenger.

New Silver Solder

➤ A low melting point silver solder, especially useful for brazing steel, brought patent 2,496,564 to Walter Soller and Gerard Kraus, both of Cincinnati, Ohio. Rights are assigned to the United States government. The solder contains silver, copper, zinc, cadmium and mercury. Gold is optional.

Heretofore, mercury has not been regarded as a desirable constituent of high strength silver solders in the belief that it is injurious to strength. In the mixtures covered in this patent an actual increase in strength is obtained, it is claimed.

Improved Oil Catalyst

➤ AN IMPROVED cracking catalyst to use in the extraction of petroleum products from crude oil is claimed to be effective in reducing the coke-forming tendencies of other catalysts. Patent 2,484,258 was awarded to Glenn M. Webb, Western Spring, and Reno W. Mochl, Brookfield, Ill., for this in-

vention. It has been assigned to Universal Oil Products Company, Chicago.

It is a silica-metal oxide catalyst. One method of preparation is uniting silica with a metal oxide, heating the composite at a temperature of from about 700 degrees to about 1,300 degrees Fahrenheit, and then suspending the composite in an aqueous solution of ammonium hydroxide at a temperature not in excess of 300 degrees Fahrenheit. Other methods of manufacturing the cracking catalyst are included.

Chemical Heat for Torpedo

➤ A CHEMICAL-HEAT power plant for underwater torpedo propulsion earned Earl A. Gulbransen, Pittsburgh, Pa., patent 2,484,221. His rights have been assigned to Westinghouse Electric Corporation. It is a device in which finely divided magnesium and hydrochloric acid are used to create the heat. The heat forms steam from water in a boiler. The steam gives the propulsion.

A small amount of water is employed also to react with the magnesium. The quantity of steam generated is regulated by controlling the supply of the acid. One important point of this type of propulsion is that the waste products of the chemical action are soluble in water and make no tell-tale trail on the ocean surface.

Super Fuel for Planes

➤ A SUPER FUEL for high-compression, internal-combustion, spark-ignition engines, particularly for airplanes, brought Robert F. Marschner, Homewood, Ill., patent 2,485,897. It has

been assigned to Standard Oil Company, Chicago. His fuel is a mixture of triptane and cyclopentane, both petroleum products. They are included in a six-to-four ratio, with a little lead tetraethyl added if desired.

Glass-to-Metal Seal

➤ A METHOD of making glass-to-metal seals, a matter of extreme importance in electronic tubes and in television, brought James E. Beggs, Schenectady, N. Y., patent 2,486,101. It has been assigned to General Electric. Other methods are in use but in this improved procedure the glass at no time in the sealing process comes in contact with any part other than the parts to be sealed together.

Electron Microscope

➤ AN IMPROVED electron microscope was awarded patent 2,485,754, the recipient being Jan Bart Le Poole, Eindhoven, Netherlands. His rights have passed to the Hartford National Bank and Trust Company, Hartford, Conn., as trustee. Its particular features are means for improving the focussing of the image of an object to be enlarged on the fluorescent screen, and means for stereoscopic observation.

Uranium and Vanadium

➤ AMONG chemical patents is an improved process of making anhydrous nitric acid containing dissolved nitrogen dioxide and also a method for the recovery of uranium and vanadium from ores. Patent 2,486,083 was awarded William E. Watson, West Orange, N. J., and John W. Glenn, Buffalo, for the nitric acid process, rights to which have been assigned to Allied Chemical and Dye

Corporation, New York City. Patent 2,485,841 was awarded to Arnold Pacyna, Lyndhurst, N. J., for the uranium process, a matter of special interest because of the use of uranium in atomic energy work.

In the first of these two patents, it is claimed a process has been discovered which makes it possible to eliminate substantially all water from the system, thus making fuming nitric acid of high total acidity, and to do this without the formation of uneconomic and troublesome by-products. In the uranium-vanadium extraction process from such ore as carnotite, pulverization, oxidation of the metals, and treatment with sodium dithiodiglycollate is the key.

Titanium and Beryllium

► Two CHEMICAL patents of interest include an improved method of obtaining titanium dioxide, widely used as a white pigment in paint, and of producing beryllium, used in making strong alloys that resist corrosion. For the first, patent 2,486,465 was issued to Lewis C. Copeland, Palmerton, and Clayton W. Farber, Bowmans-town, Pa. The patent has been assigned to the New Jersey Zinc Company, New York. For the beryllium production process, patent 2,486,475 was awarded to Henry C. Kaweckii, Temple, Pa., and has been assigned to the Beryllium Corporation of Reading, Pa.

In usual methods of producing titanium dioxide from titanium ores, two crystalline forms are obtained, anatase and rutile. The object of the present invention is an improved method of producing the pigment in its desired rutile form. The beryllium

process is claimed to provide a method of producing substantially pure metallic beryllium and also of obtaining beryllium-base alloys and light metal alloys of beryllium.

Oxygen Absorber

► AN IMPROVED method of obtaining commercial oxygen from the air for industrial uses brought Celeste M. Fontana and Everett Gorin, Dallas, Tex., patent 2,490,587. Rights have been assigned to Socony-Vacuum Oil Company of New York City.

Oxygen is now being used in volumes totaling thousands of tons per year in many industries. These include the steel industry in blast furnaces to speed production and in the fields of organic and petroleum chemistry. The process just patented is a continuous one, with a stream of air passing into a reaction zone, and continuous removal of an oxygen absorbent.

Within this zone is a mixture of potassium chloride, cupric chloride and cuprous chloride mounted on a powdered synthetic refractory oxide gel support. These copper chlorides, and their potassium chloride melts, absorb the oxygen which is readily removed in a desorption zone.

Low-Reflecting Glass

► IN THIS PROCESS, low light reflecting films are produced on glass surfaces by the chemical attack of silicon tetrafluoride vapors on the constituents of the glass. New compounds are formed with less surface reflection.

Patent 2,490,263 was issued to Romey A. Gaiser and Milton F. Schaible, Toledo, Ohio, assignors to Libbey-Owens-Ford Glass Company of the same city.

**Bone Density Study Wins Prize for
Founder of Chemistry Magazine**

Garvan Medal to Pauline Beery Mack

► FEWER BOW LEGS, stronger skeletons, easier pregnancies, and better health at all age levels can be assured through an ingenious technique which has been developed for measuring bone density in living subjects, Dr. Pauline Beery Mack of the Pennsylvania State College, 1950 winner of the Francis P. Garvan Medal, told the American Chemical Society in her Garvan Medal address.

Children with rickets and adults with many maladies involving the skeleton can be aided by application of the technique to diagnosis of their ailments and determination of the effectiveness of treatment, Dr. Mack declared.

Many cases of senile demineralization, resulting in non-healing fractures and shortened spinal columns, probably could have been avoided had their mineral history been followed earlier by this method.

Dr. Mack, who is director of the Ellen H. Richards Institute and professor of household chemistry at Pennsylvania State, founded the CHEMISTRY LEAFLET in 1917 and edited it until 1944, when she turned it over to Science Service, in order to carry on augmented research activities made heavier by the war.

Research on the development of better food, clothes, and shelter for mankind is conducted at the Ellen H. Richards Institute under Dr.

Mack's direction. The first comprehensive human nutrition studies of the modern type were inaugurated by her in 1935. This work has led to many important discoveries concerning the relationship between food intake and physical well-being.

In the field of textile chemistry, studies at the Institute have included the chemistry of silk weighting, the chemistry of dye adsorption, the development of laboratory tests for textile performance to simulate conditions of wear, and the development of physical, chemical, and practical methods of measuring detergency efficiencies. The institute's standard soiled fabrics for dry cleaning and laundry testing and research are widely known and used.

Dr. Mack, a native of Missouri, has been on the Pennsylvania State faculty since 1919. Dr. Icie Macy Hoobler of Detroit, director of the research laboratory of the Children's Fund of Michigan, who won the Garvan award for 1946, presented this year's gold medal to Dr. Mack. The prize is awarded annually to an outstanding woman chemist. Dr. Mack was honored particularly for work on the calcium chemistry of bone density which has constituted her chief personal contribution to chemical science. Her microphotometric method of measuring the mineral content of bones has been applied by many other investigators in this country and

abroad in varied studies in the fields of nutrition and medicine.

The mineral matter in bones is not rigidly fixed, as once was supposed, but is coming in and going out of the skeleton at all times, Dr. Mack explained. The skeleton serves both as a framework for the body and as a storehouse for mineral substances needed for numerous body processes. If the intake in our diets of calcium and of other mineral substances is adequate both for producing and maintaining strong bones and for performing other bodily functions, then the mineral well-being of the body is assured unless some pathological condition interferes with the proper utilization of the mineral substances which are consumed.

Dr. Mack traced the development of the equipment and the technique which make possible the quantitative measurement of the density of bones in living persons from x-rays. Before the introduction of this method the only way to appraise bone density was through visual inspection of x-rays, which was highly subjective and inaccurate. The new technique will pick up minor changes in bone density within two or three days from the time that some change in diet or therapy has been instituted.

Work on the development of an objective method for evaluating bone density from x-rays of living subjects was begun by Dr. Mack in 1927. The resulting technique—which has been brought to a high degree of objectivity—has now been applied to the x-rays of more than 13,000 human beings and to numerous experimental animals.

The method consists of the use of an electronic equipment (developed along with the method), by which the x-ray is moved through a stationary beam of light in such a way that a tracing is made of a cross-sectional slice of the bone. A standard ivory wedge of different step heights is placed on each film when the x-ray is made. A tracing of the ivory wedge enables accurate corrections to be made of differences in exposure technique made necessary when x-raying babies and large men, mice and farm animals.

By repeating the traces across a bone at close intervals, values may be obtained which are practically identical with those achieved if the bone were dissected out, weighed, ashed, and weighed again. The importance of the x-ray scanning method comes from the fact that it can be used on living persons, so that minor cases of demineralization can be corrected before much physical damage has occurred.

In an infant, for example, x-rays will not show demineralization by visual inspection until actual rickets has occurred. The densitometric x-ray tracing method will pick up extremely minor degrees of demineralization, so that dietary or therapeutic treatment can be applied immediately, thus saving a distorted chest and head, bowed legs, stunting, or easy fracturing—whichever of these types of malady follows as the undoubted outcome of poor skeletal mineralization in infancy.

In a young child, the skeleton must perform several functions if growth

and physical well-being are to be insured. The skeleton must grow; it gradually must take on new features which bring it closer and closer to maturity; it must deposit sufficient material to insure bone strength and resistance to fracturing; and it must have sufficient mineral in addition to keep the mineral content of the blood up to the level needed for proper functioning of nerves and muscles.

Failing in any one of these four functions, the child may grow and the bones may mature somewhat on schedule, but mineralization of the skeleton may be poor, with many attendant distortions of shape, or fractures may occur easily. On the other hand, the body may be stunted—nature's method of making too small an amount of mineral serve the body as efficiently as possible. Or—in extreme cases of poor body mineral sup-

ply—growth, maturity, and mineral density of the skeleton may suffer simultaneously with an upset of many other body functions.

Young children are not the only ones whose skeletal mineralization should be measured periodically by this accurate x-ray densitometric method. Children at any age may suffer many maladies as a result of consuming too little milk or other foods providing valuable minerals for the body. Adults need to have a proper mineral intake all along the line, or they suffer in a minor or major manner for this shortage. Women in pregnancy, men undergoing heavy physical work, particularly indoors, where there is no sunlight to help retain what calcium is consumed, and aging persons are particularly vulnerable in this respect.

Medical Cream Has Many Uses

► A VERSATILE medicinal cream that kills germs and fungi, stops insect bites from itching, feeds drugs into the bloodstream, promotes the healing of wounds, and deodorizes was reported to the Philadelphia meeting of the American Chemical Society.

The chemical name of the new product is cyclohexyl pyroborate, Dr. M. M. Clark and Dr. A. R. Clark of the Foxlyn Laboratories, Mountain Lakes, N. J., reported that the cream rubs into the skin without forming a greasy film or jelly.

Because it combines equally well with water soluble or organic materials, it can be mixed with almost any kind of drug for prescription use.

When applied, cyclohexyl pyroborate melts because of moisture and rubbing and forms a fluffy dry powder which is adherent but can be easily washed off with cold water. In tests the product has killed staphylococcus aureus, the golden germ found in boils, within four minutes and has proved to be non-toxic when applied to other than mucous-coated areas.

A six-ounce 36-volt storage battery is used in walkie-talkies.

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